LARVAL TREMATODES FROM AUSTRALIAN TERRESTRIAL AND FRESHWATER MOLLUSCS

PART V

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Cercaria parocellata n. sp.

Figs. 1-7

Though large numbers of *Limnaea lessoni* from the lower Murray River swamps have been examined, only one has been found to harbour *Cercaria parocellata,* the snail being collected at Swan Reach on 7 December, 1938. It died on 6 January, 1939, during excessively hot weather, and partial disintegration had taken place before it was preserved. This accounts for our failure to find complete sporocysts, though there were recovered thin empty portions and shorter thick parts containing germ balls and cercariae, some of the older more attenuated sporocysts showing the presence of orange granules in the walls.

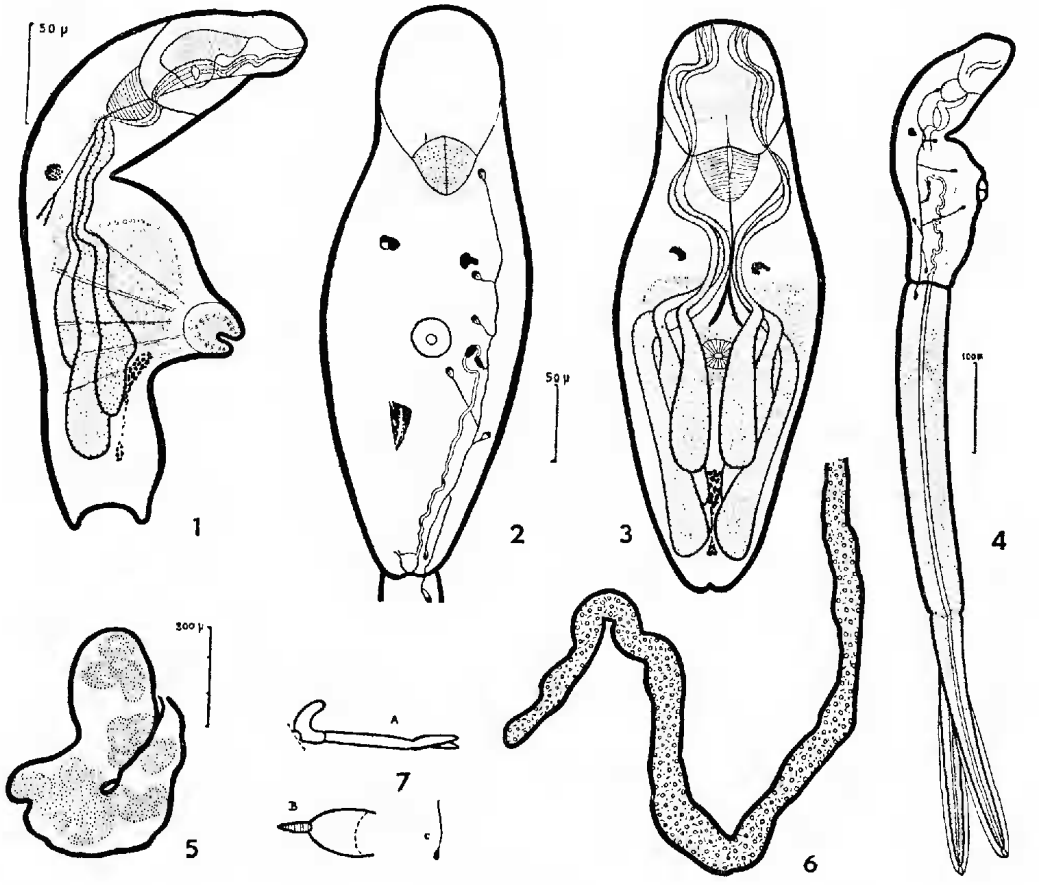
The cercaria was positively phototropic, spending most of its time resting attached to the lighted side of the glass receptacle, but sometimes rising to the surface of the water. The resting position was characteristic (fig. 7 A), the ventral sucker being thrust well forward and serving for attachment while the head region was bent backward to form an open U with the rest of the body, the tail floating out with its furcae close together or slightly crossed. When swimming a shimmering effect was produced, the cercaria moving rapidly with an irregular spinning motion and occasionally resting with the head hanging almost vertically downwards (fig. 7c), so that the organism resembled somewhat a long-handled spoon.

The average measurements of fourteen formalinised specimens were: Length of body, 282 μ; breadth of body, 54 μ; length of tail stem, 362 μ; length of furcae, 250 μ; length of anterior organ, 89 μ. The body was covered by numerous small, uniformly arranged spines, but there were no special head spines. The anterior organ was subdivided, the posterior portion being very muscular, while the anterior contained a large granular head organ with a prominent nucleus. The mouth lay ventrally on the anterior organ, and the gut was traceable as a thin line, dividing behind the level of the eyes into two short caeca. The large eyes consisted each of an aggregation of dark granules, a lens apparently being present on the ventral side of it.

The small, completely retractile ventral sucker was not provided with special hooks. The organ was usually thrust out so that most specimens appeared in side view on the slide. In formalinised material, a characteristic bend was (fig. 1) seen on a level with the eyes, the protruding sucker lying behind this region. Large muscle bands extended from the sucker to the dorsal region of the body.

The tail possessed well-developed muscles and numerous caudal bodies, the latter not readily seen. The furcae were provided each with a membranous distal fold, interrupted at the tip by the end portion of the excretory tube.

The gland cells were arranged in two groups, an anterior of two pairs of large, coarsely granular cells, and a posterior of three pairs of finely granular



Figs 1-7

Cercaria parocellata. Fig. 1, side view; 2, excretory pattern; 3, front view, specimen slightly extended; 4, whole mount, side view showing excretory system; 5, 6, portions of sporocysts; 7 A, resting position; 7 B, swimming; 7 C, suspended.

Figs. 1, 3-6 drawn with the aid of a camera lucida; figs. 2 and 3 drawn to same scale, the remaining figures to the scales indicated beside them.

cells. Their ducts followed a characteristic course (figs. 1, 3), passing through the front portion of the anterior organ to open each on a slight projection.

The gonads were represented by a large group of darkly staining cells, just posterior to the ventral sucker. Connecting this group with a smaller, more posterior group was a string of cells.

From the small excretory bladder, each main tubule passed forwards to about the level of the ventral sucker, where it formed a loop with two ciliate areas and then gave rise to an anterior and a posterior collecting tubule. There were six pairs of flame cells in the body, three cells connected with each anterior and three with each posterior tubule; and also one lying at the base of the tail (figs. 2, (4)). The main excretory tubule passed down the centre of the tail, bifurcating into the furcae to open at the tips of the latter through a small, almost bladder-like extension of the tube in the membranous fold of the corresponding furcae.

Our cercaria belongs to the schistosomes and falls into Miller's (1926) group D *(elvae* group) of apharyngeal brevifurcate distome cercariae, and into Wesenberg-Lund's (1934) *ocellata* group. It differs from the only adequately described Australian schistosome larva, *C. jaenschi* Johnston and Cleland (1937), in possessing one more flame cell attached to each posterior tubule, and in some other features. Its nearest known ally is *C. ocellata* La Val. Wesenberg-Lund (1934) gave a list of European cercariae belonging to this group, together with a description of *C. ocellata* and of the cercaria of *Bilharziella polonica.* From the latter our species differs in the relative dimensions and in the structure of the tail; *C. macrosoma* Brown (1926) possesses a different number of gland cells; while *C. echinomorpha* Brown (1931) differs in the length of body (150 μ) and furcae (120 μ) and in the non-differentiation of gland cells.

The measurements of our formalinised specimens fall within the range of those given for *C. ocellata,* except for the length of the anterior organ which averages 89 μ in the Australian cercaria, but is stated by Wesenberg-Lund to be between 37 and 56 μ in the Danish form; in the latter, this author did not observe body spines. *C. elvae* Miller (1923, 38; 1926), which is perhaps identical with *C. ocellata,* appears to be a larger cercaria than the latter (though Miller [1926, 31] stated that the former was smaller) and the Australian species. Measurements given by Miller for balsam mounts of the North American form are: Body, 368 by 41 μ; tail stem, 382 μ; furcae, 290 μ; and anterior organ, 96 μ in length.

Although the differences between *C. ocellata, C. elvae* and our form are slight, we consider it preferable, until the full life cycle is known, to regard the last mentioned as distinct, and have accordingly named it *C. parocellata.* Attempts to infect a young muscovy duck with it have been unsuccessful. *C. ocellata* is the larva of *Trichobilharzia ocellata,* a blood parasite of ducks.

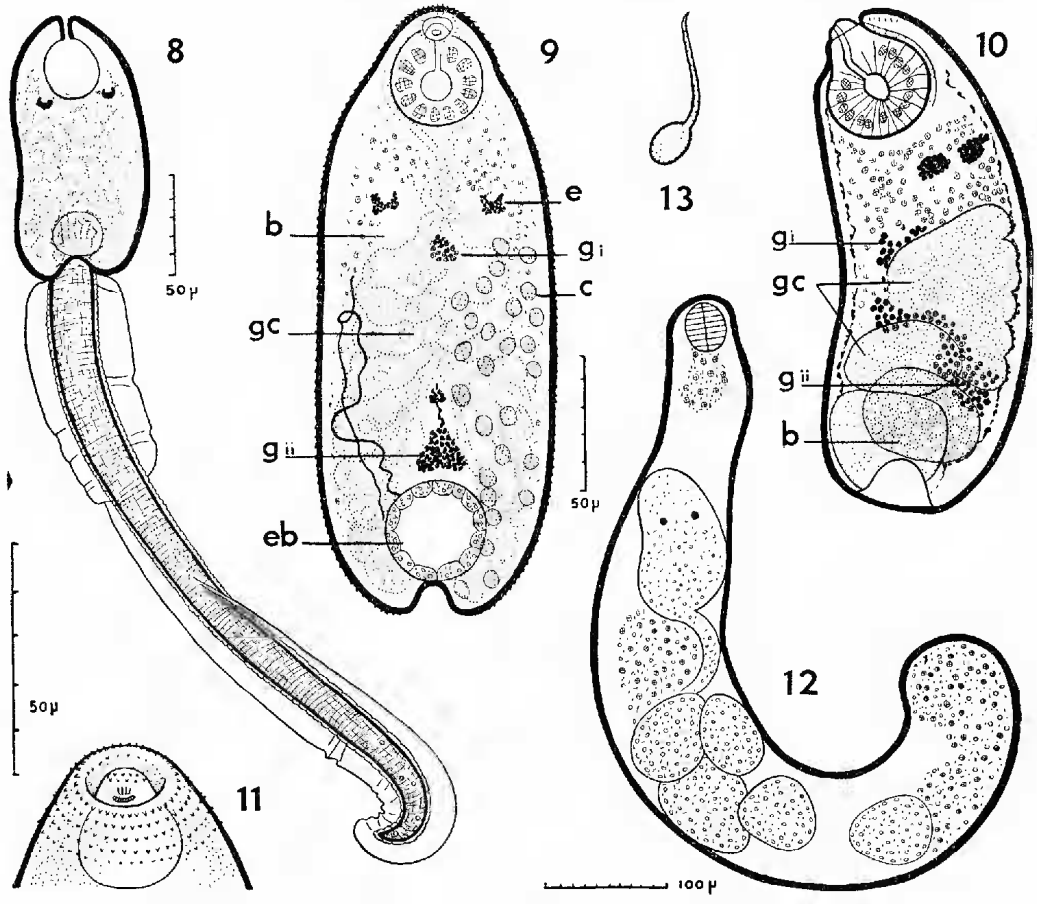
Cercaria plotiopsis n. sp.

Figs. 8-13

A species of heterophyid cercaria was given off from eighteen of 519 specimens of the Melaniid gastropod, *Plotiopsis tatei* (Brazier), collected in December, 1937, and from eighteen of 370 taken in December, 1938, all of them from Swan Reach, Murray River. The infection rates were thus about

3·4 and 5%, respectively. The larvae were clearly seen suspended upside down in the water as they sank slowly, or as they regained their position by abrupt jerky upward movements. When resting, their position was characteristic (fig. 13), somewhat resembling a spoon with a curved handle. The cercariae were positively phototropic.

The measurements of ten formalinized specimens were as follows: Length of body 110-144 μ, mean 126 μ; breadth of body 51-76 μ, mean 68 μ; mean length of anterior organ, 26 μ; mean breadth of anterior organ, 23 μ. The body,



Figs. 8-13

Cercaria plotiopsis. Fig. 8, ventral view; 9, body, ventral view; 10, body, side view; 11, head region; 12, redia; 13, resting position of cercaria.

All figures drawn with the aid of a camera lucida. b, brain; c, cystogenous cells; e, eyespots; eb, excretory bladder; g i, g ii, genital rudiments; gc, gland cells.

especially the fore part, was capable of very marked contraction and expansion. The main colour was pale brown, and superficial brown pigment granules were distributed as a network near the surface and especially aggregated around the bladder and eye spots. The latter were large and composed of a rectangular cup-shaped group of dark brown granules in the vicinity of the H-shaped brain.

The small, slightly curved body spines were arranged in rows, giving a finely wrinkled appearance to the cercaria. The spines were larger at the anterior end. In front of the spiny region was a circumoral spineless area capable of great retraction, so that the lip and the mouth could be withdrawn as though into a hood. The anterior end of the animal was not retractile. The mouth opened ventrally, had a chitinous rim, and along its upper surface were four narrow chitinous bands. Two rows of spines, the anterior containing six and the posterior five, were situated on the lip in front of these bands. The anterior organ was large. No trace of a digestive system nor of a ventral sucker was recognised. Numerous cystogenous cells were present in the body.

There were seven pairs of large lobed glands with well-defined nuclei, the cells extending from behind the eyes to the posterior end of the body. The anterior three pairs met in the centre, while the most posterior glands were arranged two on each side of the bladder. Coiled ducts passed forwards in the vicinity of the median line, and then on either side of the anterior organ, to open separately on the circumoral spineless area.

The conspicuous bladder lying at the posterior end was bounded by large cells. From it a fine excretory canal passed forward on each side, reaching a point between the second and third gland cells, where it subdivided into ascending and descending ducts. The former was traced to the level of the eyes, and the latter as far back as the level of the bladder. Flame cells were not recognised.

The tail was about 360 μ long, curved, and in side view slightly S-shaped. It had well marked longitudinal and circular muscle fibres, as well as a group of large nuclei near the tip. There were two series of membranous transparent fin-folds; an anterior lateral pair arising from the base of the tail and extending backwardly for nearly one-third of its length; and a posterior dorso-ventral fold commencing on the dorsal side just above the end of the lateral folds and extending back to the tip of the tail to become continuous with a shorter ventral fold. These fins were at times thrown into a series of folds, at first sight resembling fin-rays. Sewell (1922, 26) pointed out that such appearances were due to the contractility of the tail and vanished when the membrane was extended.

The short, usually curved, thin-walled redia at first sight suggested a sporocyst. The pharynx was succeeded by a very short gut, not readily seen. The cavity of the redia was filled with germ balls, generative tissue and developing cercariae. Mature rediae sometimes showed one or more constrictions in the distal portion of the body.

In order to obtain the encysted stage of the trematode, attempts to infect the following fish were made without success: golden carp *(Carassius auratus),* rice fish, *Pseudomugil signifer* Kner and *Melanotaenia nigrans* Richardson.

Our cercaria belongs to the Heterophyidae and very closely resembles that of *Monorchotrema taihokui* and *M. taichui* Faust and Nishigori (1926). From the latter our species does not appear to differ in any essential details. The number and arrangement of the gland cells, as well as the form and spination of the

anterior end are similar, while the body size of the Japanese form falls within the range of that of the Australian cercaria. The separation of the fin folds into lateral and dorso-ventral groups was not noted by Faust and Nishigori, but was noted by Sewell as occurring in his *Cercaria indica* vii. We failed to find a ventral sucker in our material. The bladder in our species resembled that described by Sewell for his cercaria (1922, 25) and appears to represent in shape and position the structure labelled ventral sucker in the figures (Faust and Nishigori, fig. 14) of the Japanese species. In the illustrations of the adult *Monorchotrema*, a ventral sucker is shown as lying anteriorly to the testis yet in the larva it is indicated as being posterior to that organ. In view of these discrepancies it seems likely that the organ labelled as sucker in the larva is really the excretory bladder, similar to that indicated in their fig. 20. From *Cercaria indica* vii our species differs in the number and arrangement of the gland cells.

In view of the lack of knowledge of Australian adult heterophyids, we prefer to attach a distinctive name to it, **Cercaria plotiopsis** n. sp., after the name of its host mollusc.

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